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EXAMINER

KANG, INSUN

ART UNIT PAPER NUMBER

2193

DATE MAILED: 03/13/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/844,345

Applicant(s)

ROBISON, ARCH D.

Examiner

Insun Kang

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 12 December 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-38 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-38 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                        | 4) <input type="checkbox"/> Interview Summary (PTO-413)                     |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)    | Paper No(s)/Mail Date. _____  |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____   | 6) <input checked="" type="checkbox"/> Other: <u>105 requirement</u> .      |

**DETAILED ACTION**

1. This action is in response to the amendment filed 12/12/2005.
2. Claims 1-38 are pending in the application.

***Claim Rejections - 35 USC § 101***

3. 35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

4. Claims 1-38 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

Claims 1-38 are non-statutory because they are directed to a “method, “product,” and “system” with a single step. The independent claims merely recite a “method, “product,” and “system” comprising pruning local graphs without further describing what the pruning step is and/or how the pruning step is performed creating any functional interrelationship among the punning steps. The claims do not recite a description of what the pruning step is and how the step is performed with respect to the method. Simply reciting what the local graphs are does not provide any functional interrelationship with the pruning step. Thus the claims represent non-functional descriptive material that is not capable of producing a useful result, and hence represent only abstract ideas. Therefore, the claims are non-statutory.

***Claim Rejections - 35 USC § 112***

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

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The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claims 1-38 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding claims 1, 15, and 29, the claims recite, a single step, pruning local graph and then describe the local graph representing local problems which is a simple data structure. Simply reciting a single step, "pruning local graphs" does not make the scope of the claim clear as it is unclear what the pruning local graphs step is and what is included and excluded. As per claims 2-14, 16-28, and 30-38, these claims are rejected for dependency on the above rejected parent claims. Appropriate correction is required.

***Claim Rejections - 35 USC § 102***

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

8. Claims 1-38 are rejected under 35 U.S.C. 102(b) as being anticipated by Binkley ("Interprocedural Constant Propagation using Dependence Graphs and a Data-Flow Model," 1995).

Per claim 1:

Binkley discloses:

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-pruning local graphs representing local problems, the local problems corresponding to separately compilable components in a software program (i.e. "Live-code analysis is performed...When the algorithm terminates remaining non-live vertices represent dead code that can be removed from the SDG," section 3. Interprocedural constant propagation; "The SDG for system S contains one procedure dependence graph (PDG) for each procedure in S connected by interprocedural control-and flow-dependence edges," "Connecting PDGs to form the SDG," section 2. Background)

-each of the local graphs having edges and vertices, each edge having a transfer function, each vertex having a value, values of each of the local graph forming a lattice under a partial ordering (i.e. "The PDG for procedure P contains vertices, which represent the components of P, and edges, which represent the dependence between these components," 2. 1 The System Dependence Graph; "Following the data-flow model, each flow dependence edge in the SDG is labeled by a lattice element, which represents the current best approximation to the value "flowing" down the edge," 2.3 The Constant Propagation Lattice) as claimed.

Per claim 2:

The rejection of claim 1 is incorporated, and further, Binkley discloses:

-associating a use attribute to each one of the vertices in each of the local graphs, the use attribute being asserted for each vertex reachable from a named vertex; associating an affect attribute to each one of the vertices in each of the local graphs, the affect attribute is asserted for a vertex if a named vertex is reachable from the former vertex;

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and pre-solving a subgraph of each of the local graphs, the subgraph including subgraph edges, each of the subgraph edges connecting a tail vertex to a head vertex, the tail vertex having a negated use attribute ("Live-code analysis is performed by initially labeling all vertices as non-live and then marking vertices as live only as they are encountered during constant propagation. When the algorithm terminates remaining non-live vertices represent dead code that can be removed from the SDG," section 3. Interprocedural constant propagation) as claimed.

Per claim 3:

The rejection of claim 2 is incorporated, and further, Binkley discloses shrinking the local graphs ("A vertex representing an action with a side effect...is never fired and is therefore removed from the graph only if it presents dead code," section 3.1 Interprocedural constant propagation) as claimed.

Per claim 4:

The rejection of claim 3 is incorporated, and further, Binkley discloses solving a global problem to optimize a recompilation of the separately compilation components by an inter-procedural analysis (IPA) solver, the global problem being represented by a global graph formed from the pruned local graphs ("Interprocedural data-flow analysis is used to determine which parameters and globals may be used and/or modified as a result of a procedure call," section 2.1 The system dependence graph; "Using dependence graphs and a data-flow model provides an efficient algorithm

for interprocedural constant propagation,” section 5 conclusion) as claimed.

Per claim 5:

The rejection of claim 4 is incorporated, and further, Binkley discloses determining final edges and vertex values of the local graphs to be sent to IPA solver; and sending the final edges and vertex values to the IPA solver, the final edges and vertex values forming the pruned local graphs (“Live-code analysis is performed by initially labeling all vertices as non-live and then marking vertices as live only as they are encountered during constant propagation. When the algorithm terminates remaining non-live vertices represent dead code that can be removed from the SDG,” section 3. Interprocedural constant propagation) as claimed.

Per claim 6:

The rejection of claim 2 is incorporated, and further, Binkley discloses : negating use attributes for all vertices in the local graph; and invoking a mark use operation on u for each named vertex u in the local graph (“each edge is labeled either true or false...edges from entry and call-site vertices are always labeled true,” 2.1 the system dependence graph; “Live-code analysis is performed by initially labeling all vertices as non-live and then marking vertices as live only as they are encountered during constant propagation. When the algorithm terminates remaining non-live vertices represent dead code that can be removed from the SDG,” section 3. Interprocedural constant propagation) as claimed.

Per claim 7:

The rejection of claim 6 is incorporated, and further, Binkley discloses asserting the use attribute associated with u if the use attribute is negated; and recursively invoking the mark use operation on v for each edge connecting the named vertex u to a vertex v ("each edge is labeled either true or false...edges from entry and call-site vertices are always labeled true," 2.1 the system dependence graph; "Live-code analysis is performed by initially labeling all vertices as non-live and then marking vertices as live only as they are encountered during constant propagation. When the algorithm terminates remaining non-live vertices represent dead code that can be removed from the SDG," section 3. Interprocedural constant propagation) as claimed.

Per claim 8:

The rejection of claim 2 is incorporated, and further, Binkley discloses negating use attributes for all vertices in the local graph; invoking a mark affect operation on y for each named vertex y in the local graph ("each edge is labeled either true or false...edges from entry and call-site vertices are always labeled true," 2.1 the system dependence graph; "Live-code analysis is performed by initially labeling all vertices as non-live and then marking vertices as live only as they are encountered during constant propagation. When the algorithm terminates remaining non-live vertices represent dead code that can be removed from the SDG," section 3. Interprocedural constant propagation) as claimed.



Per claim 9:

The rejection of claim 8 is incorporated, and further, Binkley discloses asserting the use attribute associated with y if the use attribute is negated; and recursively invoking the mark affect operation on x for each edge connecting the vertex x to a named vertex y (i.e. "Following the data-flow model, each flow dependence edge in the SDG is labeled by a lattice element, which represents the current best approximation to the value "flowing" down the edge," 2.3 The Constant Propagation Lattice) as claimed.

Per claim 10:

The rejection of claim 2 is incorporated, and further, Binkley discloses finding a greatest fix-point solution to the subgraph (i.e. "When a use of a variable is reached by multiple definitions, the definitions are combined by the lattice meet operator," 2.3 the constant propagation lattice) as claimed.

Per claim 11:

The rejection of claim 3 is incorporated, and further, Binkley discloses removing an incoming edge having a head value of a lattice-bottom (i.e. "When a use of a variable is reached by multiple definitions, the definitions are combined by the lattice meet operator," 2.3 the constant propagation lattice; When the algorithm terminates remaining non-live vertices represent dead code that can be removed from the SDG,"

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section 3. Interprocedural constant propagation) as claimed.

Per claim 12:

The rejection of claim 3 is incorporated, and further, Binkley discloses transforming a subgraph having first and second edges, the first and second edges having first and second functions, the first edge connecting a first vertex to an anonymous vertex having a value  $v$ , the second edge connecting the anonymous vertex to a second vertex having a value  $w$  ("Live-code analysis is performed by initially labeling all vertices as non-live and then marking vertices as live only as they are encountered during constant propagation. When the algorithm terminates remaining non-live vertices represent dead code that can be removed from the SDG," section 3. Interprocedural constant propagation) as claimed.

Per claim 13:

The rejection of claim 12 is incorporated, and further, Binkley discloses removing the anonymous vertex; removing the first and second edges; adding a third edge having a third function and connecting the first and second vertices, the third function being combined by the first and second functions; and changing value of the second vertex to a lattice meet of the second function of the value  $v$  and the value  $w$  ("Live-code analysis is performed by initially labeling all vertices as non-live and then marking vertices as live only as they are encountered during constant propagation. When the algorithm terminates remaining non-live vertices represent dead code that can be removed from the SDG," section 3. Interprocedural constant propagation) as claimed.

Per claim 14:

The rejection of claim 15 is incorporated, and further, Binkley discloses determining each of the final edges as edge having asserted use and affect attributes for tail and head vertices, respectively; and eliding each of the vertex values having a top value (i.e. "When a use of a variable is reached by multiple definitions, the definitions are combined by the lattice meet operator," 2.3 the constant propagation lattice; When the algorithm terminates remaining non-live vertices represent dead code that can be removed from the SDG," section 3. Interprocedural constant propagation) as claimed.

Per claims 15-28, they are the computer program product versions of claims 1-14, respectively, and are rejected for the same reasons set forth in connection with the rejection of claims 1-14 above.

Per claims 29-38, they are the system versions of claims 1-5 and 10-14, respectively, and are rejected for the same reasons set forth in connection with the rejection of claims 1-5 and 10-14 above.

### ***Response to Arguments***

9. Applicant's arguments filed 12/12/2005 have been fully considered but they are not persuasive.

Per claims 1, 15, and 29:

The Applicant states that:

The PDG is not a local graph representing local problems that correspond to separately compilable components in a software program. It is a graph for each procedure and the edges merely represent the dependence between the components, not a transfer function. The vertex represents the predicates of if and while statements,...Therefore, it does not have a value.

In response, the background section of the instant invention clearly defines the translation unit as a subroutine, a function, or any other separately compilable software entity (see page 1). A subroutine or a function is another separately compilable software entity according to the definition. Also, the applicant clearly states that “a “separately compilable component may represent any component that can be separately compiled such as a function, a procedure, a module, a package, or a class (see page 11).” Therefore, Brinkley’s dependence graphs for each procedure represent separately compilable software entities.

Brinkely clearly states that flow dependence edge run from a vertex that represents an assignment to a variable x to vertex that represents a use of variable reached by that assignment (page 3). The assignment is to set the value of the variable. Also, Brnikely states that initial definition vertices represent the assignment of the value 0 to these variables (page 3). Therefore, the applicant’s argument that the vertex does not have a value is not persuasive.

Brinkely discloses summary edges that represent transitive dependences due to calls (page 3) and transfer function which descres how a vertex affects the solution as a function of the behavior of other vertices (i.e. a summary edge connects actual-in vertex v at a call-site to actual-out vertex u at the same call site if there is a path in the SDG from v to u that respects calling context by matching calls with returns...a parameter-in

edge connects each actual-in vertex...actual-out vertex at all call sites (page 3). The data flow computing model of Brinkely describes the interaction of vertices and each vertex is formalized by its transfer function.

Per rejections under 35 USC § 101:

The applicant argues that the pruning local graphs step is “statutory and separately compilable components correspond to tangible and useful result, not abstract idea.”

In response, the separately compilable component is disembodied arrangement so as to be called a “computer program” or compilation of facts, information, or data *per se* that represents non-functional descriptive material that is not capable of producing a useful result, hence representing only abstract ideas. A useful process or method is a series of steps performed upon some physical object and producing in the object some change of character, condition or place. The single action “pruning a local graph” does not produce a useful, concrete, and tangible final result. Hence, the claims are non-statutory and the rejection under 101 is maintained.

Per rejection under 112, see the rejection above.

### ***Conclusion***

**10. THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within

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TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Insun Kang whose telephone number is 571-272-3724. The examiner can normally be reached on M-F 7:30-4 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kakali Chaki can be reached on 571-272-3719. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). Any inquiry of a general nature or relating to the status of this application should be directed to the TC 2100 Group receptionist: 571-272-2100.

I. Kang  
AU 2193



1. An issue of public use or on sale activity has been raised in this application. In order for the examiner to properly consider patentability of the claimed invention under 35 U.S.C. 102(b), Applicant and the assignee of this application are required under 37 CFR 1.105 to provide the following information that the examiner had determined is reasonably necessary to the examination of this application.

2. The information on the version(s) of KAI C++ compiler released prior to 4/27/2000 is required to identify products and services embodying the disclosed subject matter of claims 1-38.

2.1) Please state whether the subject matters in claims 1, 15, and 29 are included in at least one of the released version(s).

2.2) Specifically, please state whether the subject matter disclosed in claims 2-14, 16-28, and 30-38 are included in at least one of the released version(s).

3. The fee and certification requirements of 37 CFR 1.97 are waived for those documents submitted in reply to this requirement. This waiver extends only to those documents within the scope of the requirement under 37 CFR 1.105 that are included in the applicant's first complete communication responding to this requirement. Any supplemental replies subsequent to the first communication responding to this requirement and any information disclosures beyond the scope of this requirement

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under 37 CFR 1.105 are subject to the fee and certification requirements of 37 CFR 1.97 where appropriate.

4. The applicant is reminded that the reply to this requirement must be made with candor and good faith under 37 CFR 1.56. Where the applicant does not have or cannot readily obtain an item of required information, a statement that the item is unknown or cannot be readily obtained will be accepted as a complete reply to the requirement for that item.

5. This requirement is an attachment of the enclosed Office action. A complete reply to the enclosed Office action must include a complete reply to this requirement. The time period for reply to this requirement coincides with the time period for reply to the enclosed Office action.

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